CLAIMS

We claim:

1. A method for tagging an object with a tag, wherein said method comprises affixing at least two radioisotopes to said object, wherein the quantity of each radioisotope of said at least two radioisotopes is controlled to produce a controlled ratio of quantities of each radioisotope relative to the other radioisotopes of said at least two radioisotopes, wherein said controlled ratio encodes digital information within said tag which numeric content can be recovered over time-intervals by use of appropriate detection apparatus.

2. The method of Claim 1, wherein at least one radioisotope of said at least two radioisotopes comprising said tag are employed to encode the time-since-creation of said tag.

3. The method of Claim 1, wherein said tag is employed for purposes of object identification.

4. The method of Claim 1, wherein said quantity of each radioisotope of said at least two radioisotopes does not exceed 1 microCurie of decay activity at the time of creation of said tag.

5. The method of Claim 1, wherein said tag comprises a digital bit-string representation encoded with some redundancy.

6. The method of Claim 1, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides that are not practically detectable in the pertinent environment of said tag.

7. The method of Claim 1, wherein at least one radioisotope of said at least two radioisotopes comprises a radionuclide in a specified amount to encode the numerical content of a binary bit-string whose length is at least one bit.

8. The method of Claim 1, wherein said object comprises a material object of essentially greater than microscopic scale.

9. The method of claim 5, wherein said redundancy comprises a Hamming error-syndrome built into said tag.

10. The method of Claim 1, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides, wherein said radionuclides are carried on at least one bead of an ion-exchange or zeolite variety.

11. The method of Claim 1, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides, wherein said radionuclides are metered out from at least one solution-containing reservoir of an inkjet-type printing mechanism under algorithmic control.

12. The method of Claim 1, further comprising controlling detection of said tag and numeric content read-out processes with a digital computer-implemented algorithmic means.

13. A method for tagging any object with a tag, wherein said method comprises tagging said object with at least two radioisotopes deposited in a pattern that can be determined with an appropriate detector-and-collimator arrangement, wherein each radioisotope of said at least two radioisotopes comprises a specified quantity of radionuclides relative to each of the other radionuclides of said at least two radioisotopes to produce a relative mixture of radionuclides, wherein numeric information is encoded in said relative mixture of radionuclides.

14. The method of Claim 13, wherein each radioisotope is deposited on said object or upon a tag to be affixed to said object using ink-jet technology.

15. The method of Claim 13, wherein each radioisotope is deposited on said object using ink-jet technology, wherein each radioisotope is delivered to said object with the ink typically resident in an ink-jet cartridge of said ink-jet technology, resulting in a watermark visible to said detector-and-collimator arrangement.

16. The method of Claim 14, wherein each said radioisotope is delivered from an ink-jet cartridge from which the ink has been removed to produce low level radioactive tags incorporated invisibly onto previously existing objects.

17. The method of Claim 13, wherein said radionuclides emit penetrating high-energy gamma rays.

18. The method of Claim 13, further comprising determining the approximate date at which an object was tagged by measuring the decay of at least one radioisotope of said at least two radioisotopes, wherein said at least one radioisotope comprises a precisely known quantity of deposited radionuclide with an appropriate half life.

19. The method of Claim 13, further comprising creating two dimensional signature logos visible to low energy gamma-ray watermarks.

20. The method of claim 19, further comprising identifying said two dimensional signature logos with a modern strip gamma-ray detector.

21. The method of claim 19, further comprising identifying said two-dimensional signature logos with Compton gamma-ray imaging detectors.

22. The method of claim 13, further comprising creating and identifying three-dimensional logo patterns using the gamma-ray tomography.

23. A method for identifying an object, wherein said method comprises directing a high-energy radioactive ion beam at said object, wherein an energy distribution is induced upon said ion beam by said object, wherein said energy distribution is used to record of a unique signature upon or within said object.

24. The method of claim 23, wherein said object induces a stopping power on said ion beam, wherein said high-energy radioactive ion beam comprises a characteristic beam energy/direction, wherein said characteristic

beam energy/direction versus said stopping power of said object provides a unique three-dimensional signature upon or within said object.

25. The method of claim 13, wherein said information comprises information about the source, origin, ownership or history of said object

26. The method of claim 13, wherein information about said object is encoded in a spatial distribution of each radionuclide relative to the other radionuclides of said at least two radioisotopes.

27. The method of claim 26, wherein said pattern comprises a bar-code.

28. The method of claim 13, wherein said object includes a surface selected from a group consisting of a flat surface and a smooth surface.

29. The methods of claim 10 or of claim 15, further comprising incorporating low-level radioactive tags into a label.

30. The method of claim 29, further comprising affixing said label to said object.

31. The method of claim 30, wherein said object comprises something which is often counterfeited.

32. The method of claim 31, wherein said things which are often counterfeited comprise currency.

33. The method of claim 31, wherein said things which are often counterfeited comprise media bearing computer software.

34. The methods of claim 10 or of claim 16, wherein said previously existing objects comprise works of art.

35. The method of claim 16, wherein said previously existing objects comprise documents.

36. The method of claim 17, further comprising determining the presence of a tagged document in a set of documents by detecting said penetrating high-energy gamma rays.

37. The method of claim 18, wherein at least one radionuclide of said at least two radioisotopes is distributed throughout said tag.

38. The method of claim 18, wherein at least one radionuclide of said at least two radioisotopes is placed in a limited area or volume of said tag.

39. The method of claim 38, wherein said limited area comprises one line of a bar code.

40. The method of claim 39, wherein said bar code is invisible to the unaided eye.

41. The method of claim 2, wherein at least two radioisotopes are employed to encode said time-of-creation of said tag, wherein the ratio of the intensities of two gamma-ray-emitting transitions of two radioisotopes of different half-lives is made to be equal in said watermark, by convention, wherein at any later time, the then-observed ratio of line intensities of said transitions constitutes a 'clock' whose 'elapsed time-reading' may be determined as precisely as desired, simply by choosing how long to inspect the clock.

42. The method of claim 2, wherein said time-of-creation of said tag is initiated by placing a fixed, reference amount of a single clock radionuclide in said tag, wherein the age of said tag is determined by the fraction of the reference amount which remains.

43. The method of claim 2, wherein said tag comprises a signature, wherein the content of said signature comprises a sequence of bits in a binary bit-string of dozens of bits in total length, and is encoded by fixing the ratio of the line-intensity of the gamma-radiation from a radioisotope to a reference line-intensity,

translated back to the time of creation of said tag by use of the time interval encoded in said clock.

44. The method of claim 43, wherein said signature comprises code blocks, wherein the ordering of said code blocks to constitute the total digital signature is, from highest order to lowest order bit in the signature, that bit-string decoded from the relative amplitude of lowest-energy gamma-ray spectral line, and then other code blocks sequentially in order of increasing originating gamma-ray spectral energy, all the way up to the code block arising from the highest energy line.

45. A gamma watermark, comprising:

a tag comprising at least two radioisotopes, wherein the quantity of each radioisotope of said at least two radioisotopes is controlled to produce a controlled ratio of quantities of each radioisotope relative to the other radioisotopes of said at least two radioisotopes, wherein said controlled ratio encodes digital information within said tag which numeric content that can be recovered over time-intervals by use of appropriate detection apparatus.

46. The gamma watermark of Claim 45, wherein at least one radioisotope of said at least two radioisotopes comprising said tag encode the time-since-creation of said tag.

47. The gamma watermark of Claim 45, wherein said tag is affixed to an object for purposes of identification of said object.

48. The gamma watermark of Claim 45, wherein said quantity of each radioisotope of said at least two radioisotopes does not exceed 1 microCurie of decay activity at the time of creation of said tag.

49. The gamma watermark of Claim 45, wherein said tag comprises a digital bit-string representation encoded with some redundancy.

50. The gamma watermark of Claim 45, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides that are not practically detectable in the pertinent environment of said tag.

51. The gamma watermark of Claim 45, wherein at least one radioisotope of said at least two radioisotopes comprises a radionuclide in a specified amount to encode the numerical content of a binary bit-string whose length is at least one bit.

52. The gamma watermark of Claim 45, wherein said object comprises a material object of essentially greater than microscopic scale.

53. The method of claim 49, wherein said redundancy comprises a Hamming error-syndrome built into said tag.

54. The gamma watermark of Claim 45, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides, wherein said

radionuclides are carried on at least one bead selected from a group consisting of an ion-exchange bead and a zeolite bead.

55. The gamma watermark of Claim 45, wherein at least one radioisotope of said at least two radioisotopes comprises radionuclides, wherein said radionuclides are metered out from at least one solution-containing reservoir of an inkjet-type printing mechanism under algorithmic control.

56. The gamma watermark of Claim 55, wherein said radionuclides emit penetrating high-energy gamma rays.

57. The gamma watermark of Claim 54, wherein said at least one radioisotope comprises a precisely known quantity of deposited radionuclide with an appropriate half life, wherein the approximate date of emplacing said tag on an object is determinable by measuring the decay of at least one radioisotope of said at least two radioisotopes.

58. The gamma watermark of Claim 45, wherein said at least two radioisotopes are encode time-of-creation of said tag and comprises different half-lives, wherein the ratio of the intensities of two gamma-ray-emitting transitions of said at least two radioisotopes is made to be equal in said tag, by convention, wherein at any later time, the then-observed ratio of line intensities

of said transitions constitutes a 'clock' whose 'elapsed time-reading' may be determined as precisely as desired, simply by choosing how long to inspect the clock.

59. The gamma watermark of Claim 45, wherein said tag is encoded with information including the time-of-creation of said tag, wherein said time-of-creation of said tag comprises a fixed, reference amount of a single clock radionuclide in said tag, wherein the age of said tag is determined by the fraction of the reference amount which remains.

60. The gamma watermark of claim 45, wherein said tag comprises a signature, wherein the content of said signature comprises a sequence of bits in a binary bit-string of dozens of bits in total length, and is encoded by fixing the ratio of the line-intensity of the gamma-radiation from a radioisotope to a reference line-intensity, translated back to the time of creation of said tag by use of a time interval encoded in said clock.

61. The gamma watermark of claim 60, wherein said signature comprises code blocks, wherein the ordering of said code blocks to constitute the total digital signature is, from highest order to lowest order bit in the signature, that bit-string decoded from the relative amplitude of lowest-energy gamma-ray spectral line, and then other code blocks sequentially in order of increasing originating gamma-ray

spectral energy, all the way up to the code block arising from the highest energy line.